

**A PROPOSAL FOR EXPANSION
OF
SEPTA'S LIGHT RAIL NETWORK**

Prepared by

Planning and Development Department

in coordination with Operations Division

March, 1992

Revised - December, 1992

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Introduction

This is a proposal to construct new high-speed light rail lines providing direct service from Northeast Philadelphia and the Schuylkill Valley area to Center City Philadelphia.

Additionally, the plan calls for the elimination of two existing surface streetcar routes, the creation of one new surface light rail line (Route 52), the purchase of articulated light-rail vehicles, the creation of a Penns Landing-Old City light rail loop and the establishment of an historic trolley operation in Chestnut Hill-Germantown. The Chestnut Street Transitway would become a light rail corridor, and three Regional Rail branches would be converted to light rail, as well as some existing and abandoned freight branches.

Passengers from the Far Northeast would be able to reach Center City in 32 minutes with a one-seat ride, and most bus routes in the Northeast would be modified to serve new light rail stations. As many as 16,000 parking spaces could be created at light rail stations.

Both the Northeast and Schuylkill Valley lines would result in operating ratios which would be greatly improved over the existing Regional Rail operating ratios on the Fox Chase (40%), Norristown (32%) and Ivy Ridge (6%) lines. Service would be much more frequent, and ridership would increase substantially.

The construction of these lines would be expected to make a significant contribution toward reducing traffic congestion on adjacent expressways, including the Delaware Expressway, the

Schuylkill Expressway, the Pottstown Expressway and the considerable bottleneck on Route 202 which occurs in the King of Prussia area. In so doing, the two lines would alleviate the most severe traffic problems which occur in the Philadelphia region.

And the Northeast Metro would, of course, finally fulfill the need for rapid rail transportation to the northeastern part of the city, a need which has been discussed and studied for 80 years.

It is proposed that the Northeast Metro, the Schuylkill Valley Metro and the Penns Landing-Old City Loop be constructed as standard gauge rail lines, principally so that they can use existing railroad tracks where feasible. The remainder of the city's light rail network would remain wide-gauge, and Route 52 would be built as a wide-gauge line.

Creation of the standard gauge lines and the improvements to the wide gauge lines would be phased separately. For the standard gauge lines and the Penns Landing-Old City Loop, the Northeast Metro would be Phase I; the Schuylkill Valley Metro as far as Norristown would be Phase II, and the extension to Oaks and Route 422 would be Phase III. For the wide gauge lines, the extension of Route 10 to Overbrook should be programmed first; no capital costs would be required to operate Route 15 to Overbrook. Phase II would be the electrification of Route 52.

This report attempts to estimate construction costs and operating costs, (using the "Light Rail Transit Capital Cost Study" recently published by the Federal Transit Administration) as well as projected ridership, running times, comparisons with existing services, parking potential at each station and other items. It

must be noted, however, that most of these figures are very preliminary and were not the result of intensive studies. All of the numbers used in this report must be verified with much more extensive investigation. They are strictly preliminary estimates.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA-91) allows several possibilities to fund the light rail lines proposed in this report. Federal funds allocated to transit or highway construction are available for transit capital projects. Certain of the proposed lines may qualify for funding under the Transit Formula Programs as either New Starts or Rail Modernization, while others would be strictly considered as New Starts. New Start monies may also be used for advance acquisition of right-of-way.

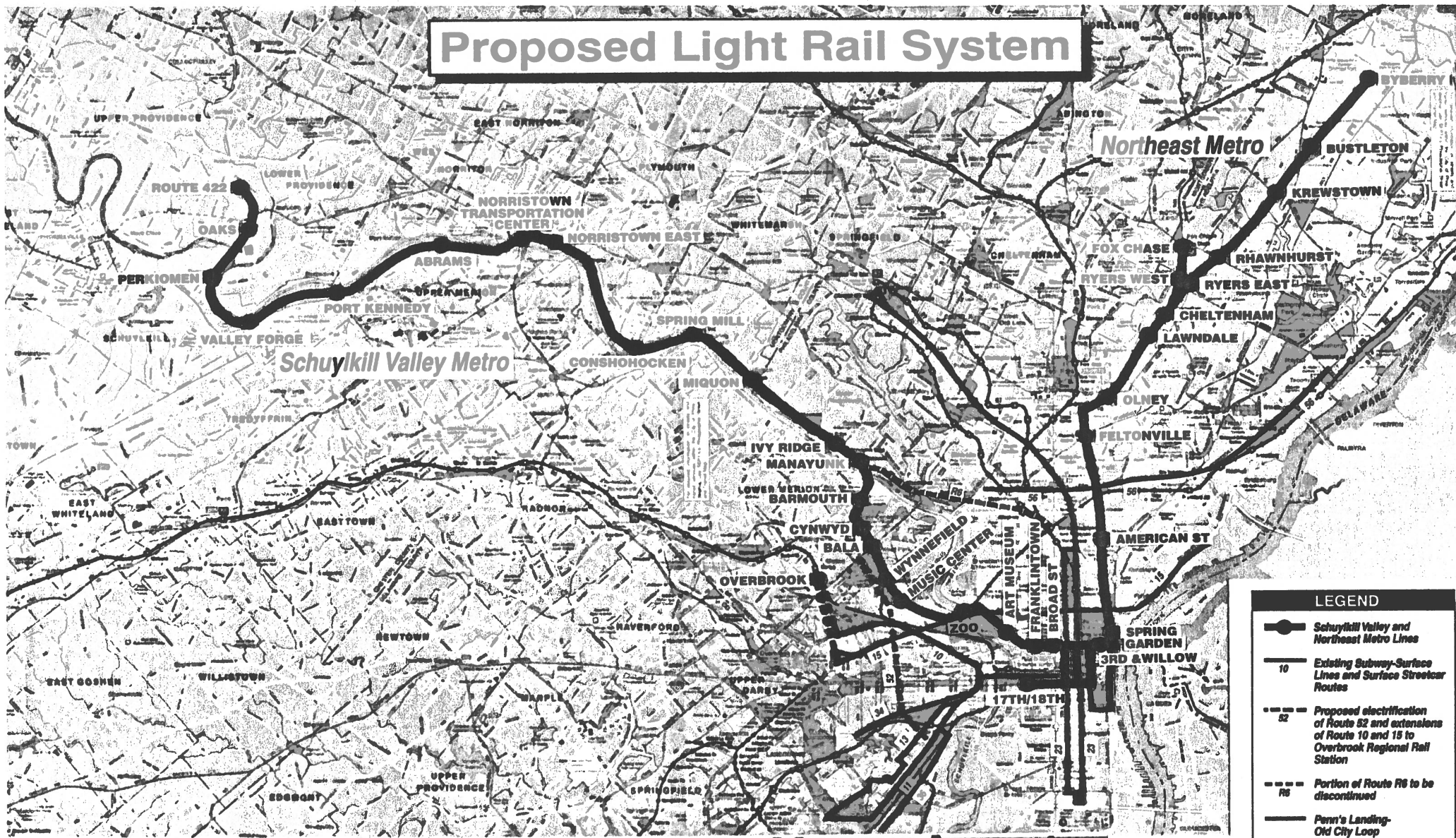
The ISTEA-91 Act, allows for funding flexibility for transportation improvements, by providing local decision makers the option of using highway funds for transit projects under the three following categories:

- National Highway System funds
- Surface Transportation Program funds
- Congestion Mitigation and Air Quality Program funds

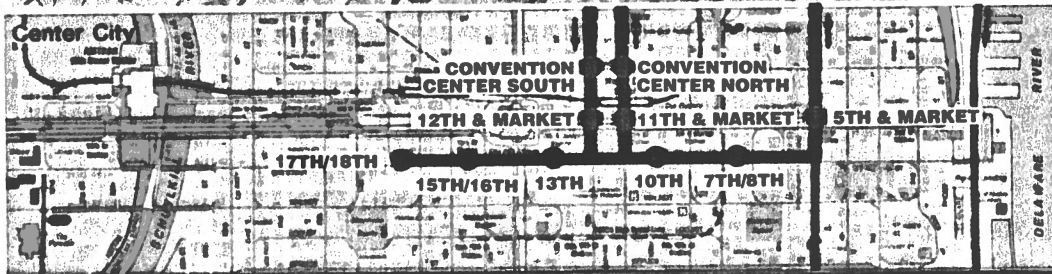
A project must be in the State Implementation Plan (SIP) of projects to improve air quality in order to qualify for the last category of funds.

If a project is to be built in an Air Quality Non-attainment Area as designated by the EPA, (which Philadelphia is) and is designated on the State Implementation Plan (SIP) as a project to improve air quality, then the normal alternatives analysis requirement to receive funding can be waived. This can reduce the amount of time to start a project by a year or more.

Proposed Light Rail System



LEGEND	
	Schuylkill Valley and Northeast Metro Lines
	Existing Subway-Surface Lines and Surface Streetcar Routes
	Proposed electrification of Route 52 and extensions of Route 10 and 15 to Overbrook Regional Rail Station
	Portion of Route R6 to be discontinued
	Penn's Landing-Old City Loop



Center City Trackage Map for the Northeast and Schuylkill Valley Metros

Schuylkill Valley Metro
To Route 422

Northeast Metro
To Byberry

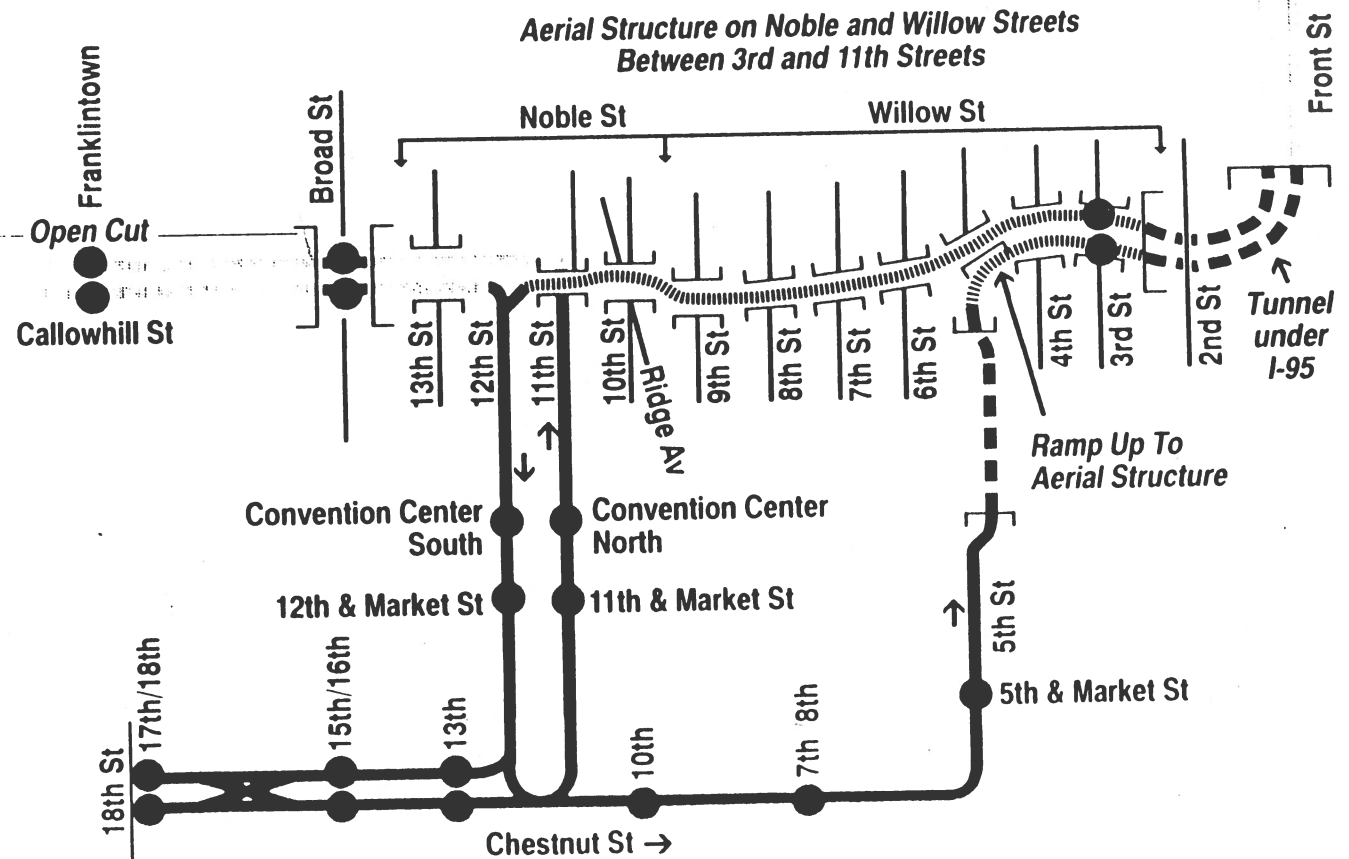
6 B



LEGEND

- Street Running
- Reserved Right of Way
- Trackage in Tunnel (Underground)
- Trackage on Aerial Structure
- Stations

1992 MTA Cartography Dept
March 1992



Northeast Metro

The proposed Northeast Metro is actually two lines. The main route would run from the grounds of the former Byberry Hospital directly to Center City. A branch line would serve Fox Chase, with trains also directly to Center City.

It is estimated that trains would run every three minutes during peak periods on the trunk portion of the route, and not all trains would make every stop between Ryers and Spring Garden. The route has been purposely designed with very few stations north of Center City and south of Olney Station. There are already many routes serving most of the neighborhoods south of Olney, and travel time from Center City is generally reasonable. The purpose of the Northeast Metro is to provide fast, frequent and direct service from points in the upper Northeast to Center City. Peak hour trains from Byberry Station would skip some stations south of Ryers in order to reach Center City as quickly as possible. These stations would be served by Fox Chase trains.

In Center City, light rail cars would use Chestnut Street in an eastbound direction between 12th Street and 5th Street. There would be no layover point in Center City; cars would continue moving through the Center City loop, and operators would receive a layover at the north end of the routes. Except for Chestnut Street, which would be devoted exclusively to light rail trains, there would be relatively little street running on the line. An abandoned railroad freight line would be used for a large portion

of the line, and the existing Regional Rail Fox Chase Line and portions of Conrail's New York Short Line right-of-way would be used for operation in the Northeast. It is proposed that at no point would light rail cars and Regional Rail trains or freight trains share the same trackage.

Up to three articulated cars would be coupled together in peak periods to form trains which would seat about 225 passengers. Trains would operate at speeds up to 65 miles an hour. Two-car trains would be used in the midday and on Saturdays. There would be only one crewman per train. Tickets would be required to be purchased prior to boarding, with no exceptions. Tokens would be accepted on the first car only. Ticket vending machines would be located at each station, and validation machines would be located on board the cars. Roving inspectors would impose stiff fines for passengers attempting to ride free.

Standard City Transit Division fares would be charged on this line.

Following is an explanation of the proposed alignment for the Northeast Metro:

Beginning at a terminal station located midway between Southampton Road and Byberry Avenue, the route would utilize a portion of the old New York Short Line of the former Reading Company, now owned by Conrail. The line was originally two tracks, although in most areas a third track could be constructed on the right-of-way. Conrail now uses only one track. The Northeast Metro would be a double-track line, except for short stretches where that may prove impossible, including the long double-track

viaduct over Krewstown Road.

The New York Short Line merges with the Fox Chase Line just south of Ryers Station. All existing stations on the Fox Chase Line would be served by the Northeast Metro. The light rail cars would leave the Fox Chase-New York Short Line at Fisher Avenue just west of 6th Street, and a connection with the former Reading Company Tabor Branch would be built. The Tabor Branch, a double-track line now abandoned but intact, passes underneath the Fox Chase Line.

Newtown Junction on the Regional Rail system, which connects the Fox Chase branch to the main line, could be eliminated.

Running south on the grade-separated Tabor Branch will bring the light rail cars to the north end of American Street, an extremely wide boulevard with abandoned railroad freight tracks in the center. A double-track light rail line would be constructed on reserved right-of-way in the middle of American Street, and half of the cross streets--which are little used--would be modified so that they would not cross the tracks. The remaining cross streets would be protected with signals and gates, permitting rail cars to operate through the American Street corridor at about 35 miles an hour.

At the bottom of American Street, Cadwallader Street would be turned into private right-of-way for the trolley for its two blocks between American and Girard Avenue. Girard would be crossed at grade, and trains would operate on 2nd Street for one block to reach Germantown Avenue. Trains would operate on the eastern side of 2nd Street, with the northbound track in reservation and the

southbound track in the bed of 2nd Street, which is one-way southbound. The two blocks of Germantown Avenue between 2nd and Front are wide and little used. Double-track private reservation would be established on the south side of the street without impacting auto traffic. Front Street between Germantown and Willow Street is also little used, having been cut off south of Willow by the construction of Interstate 95. At Front and Willow, tracks would go under I-95 and 2nd Street, emerging in Willow Street just west of 2nd Street. This is a new tunnel which would have to be constructed. Portions of Willow and Noble Streets would be abandoned to highway traffic. Between 2nd and 3rd Streets, light rail cars would climb onto an elevated line to be constructed over Willow and Noble Streets so that trains would not have to contend with grade crossings and heavy volumes of auto traffic at nine cross streets. Trains would come down to surface level between 11th and 12th Streets, then operate at grade in 12th Street from Noble to the Chestnut Street Transitway, with stops at the Convention Center and at Market Street. It may be feasible to relocate the tracks to a curb lane of 12th Street.

On Chestnut Street, the track would run in the eastbound lane, using the sidewalk area for loading and unloading. Trains would run north on 5th Street, using the existing tunnel under the Benjamin Franklin Bridge, and rejoin the line at 5th and Willow Streets for the return trip to the Northeast.

It is estimated that a trip from Byberry Station to 12th and Market Streets would take 32 minutes in peak periods. From Fox Chase to 12th and Market would take 28 minutes. A table comparing

existing and proposed trip times from each Northeast Metro station appears in this report.

With three-car trains operating every three minutes, this line would need approximately 90 articulated cars, including spares. Maintenance facilities would be constructed somewhere along the route, possibly on American Street.

Turning the Route R8 Fox Chase Line into a light rail operation would release nine Silverliners for service on the rest of the Regional Rail network.

It is estimated that the Northeast Metro would carry 35,000 passengers daily and would cost \$17 million per year to operate. Revenue would amount to \$9 million per year. Construction costs are estimated at \$469 million. Tables showing these costs, as well as other data, appear in this report.

Penns Landing-Old City Loop

As an adjunct to the Northeast Metro, it is proposed to construct and operate a Penns Landing-Old City Loop, which would connect the waterfront area with the Independence National Park historic district.

Tracks of the Philadelphia Belt Line Railroad on Delaware Avenue now utilized by the Penns Landing Trolley Association, an operating museum, would be incorporated into this route. So also would the tracks of the Northeast Metro from 5th and Chestnut Streets north to Front Street just below Spring Garden Street.

Beginning at 5th and Chestnut Streets, cars would operate via the Northeast Metro tracks to Front below Spring Garden Street where they would turn eastward for a block to reach Delaware Avenue. The single track of the Philadelphia Belt Line Railroad, in the median of Delaware Avenue, would carry the line south along the waterfront. The line would turn west at a point yet to be determined and operate in city streets to reach 5th Street, where it would run north to Chestnut. A layover point utilizing a siding or trackage against the curb would be established at 5th and Chestnut Streets, right next to Independence Hall.

A connection between Delaware Avenue and 5th Street on the south end of the line is difficult but not impossible because most cross streets have been cut off by the construction of Interstate 95.

With the future development of the waterfront, this line may be able to operate as a normal transit route, running in a clockwise direction only. Frequency would be every 7-1/2 minutes. While articulated cars would not be required for this service, they are recommended because of the flexibility they would offer. Cars from the Northeast Metro arriving in Center City at the end of the morning peak period, for example, would be able to go into service on the Penns Landing-Old City Loop.

Using articulated cars on the loop route would also permit a virtually unlimited number of cars to be put into service on the line during special weekend events that would attract thousands of people to the waterfront area.

There is also the possibility that weekend service on the line could be operated by the Penns Landing Trolley Association using its antique streetcars.

Schuylkill Valley Metro

This is a proposal to convert Regional Rail Route R6 Norristown-Ivy Ridge into a light rail line with faster and much more frequent service levels. An extension would be constructed 10.1 miles westward from Norristown to serve Upper Merion Township, Phoenixville and the burgeoning Pottstown Expressway (Route 422) corridor.

The route would be constructed in two phases. The Center City to Norristown Transportation Center portion would be first, and the extension westward to Route 422 would be opened later, although some right-of-way for this extension would need to be secured as soon as possible.

SEPTA's Capital Program has for many years called for extending Route R6 from its present terminus at Elm Street, in Norristown northward to a large parking lot, which was always presumed to be around Germantown Pike.

This would be on the old Stoney Creek branch, which ran from Norristown to Lansdale. A recent study by the Montgomery County Planning Commission reveals that it may be possible to construct as many as 600 parking spaces at Germantown Pike, but the availability of the land is uncertain.

Six hundred spaces would probably not be adequate to justify a rail extension, and the next available location would be at Skippack Pike, which is more than half the distance to Lansdale. This would then cause the line to compete with SEPTA's Route R5 Lansdale-Doylestown line, which has more frequent and faster

service.

Rather than establishing two lines which would compete for the same group of riders, it would make much more sense to extend the Norristown line westward, into a rapidly growing area, where there is no rail or express bus service.

It is estimated that express trains on the Schuylkill Valley Metro would ultimately run to Norristown and Route 422 every 10 minutes during peak periods, with local service to Ivy Ridge every 8-1/2 minutes. Express trains would make every stop from Route 422 to Ivy Ridge, then Bala, then Art Museum and all other Center City stations. Stations served only by local trains would include Manayunk, Barmouth, Cynwyd, Wynnefield, Music Center and Zoo.

Three car articulated trains would be operated during peak periods.

The Schuylkill Valley Metro would permit passengers to reach Center City from Norristown in 32 minutes during peak periods, compared with the existing 41 minutes for Regional Rail trains and 50 minutes via the Norristown High-Speed Line and Market-Frankford Subway Elevated.

Maximum frequency would be 6 trains an hour during peak periods from Norristown and 13 trains an hour from Ivy Ridge and Bala, which would be served by express and local trains. Today's service level on Regional Rail is two and two, respectively. Bus Routes 44 and 121 would be terminated at the Bala station, with passengers transferring to light rail trains to complete their trips to Center City. Some bus routes in the Roxborough-Manayunk area would also transfer passengers to rail cars.

The Schuylkill Valley Metro would provide a viable alternative to driving for commuters from the Phoenixville-Royersford and Pottstown areas, and would alleviate the chronic traffic congestion which exists daily on portions of Route 422, Route 202 and the Schuylkill Expressway.

The terminal station for the line would be located between the eastbound and westbound lanes of Route 422 in Upper Providence Township. The lanes are far apart at this point, and a parking lot for as many as 2,500 cars could be constructed here, with access directly from Route 422 and from local roads.

Leaving the Route 422 terminal, trains would pick up the abandoned right-of-way of the Reading's Perkiomen Branch, with a station at Oaks to serve the residential community, the industrial park and a proposed shopping center. The line would be single track across the Schuylkill River, where it would join with the old Reading Main Line, now Conrail's Harrisburg line. This right-of-way is four tracks wide. Two would be retained by Conrail and two would be used for the Schuylkill Valley Metro, with stations at Perkiomen (serving Phoenixville), Valley Forge, Port Kennedy and Abrams. The Port Kennedy Station is a five-minute bus ride from the King of Prussia Industrial Park. Abrams Station is at the end of Henderson Road, in the northern part of Upper Merion Township. Crossing the Schuylkill River between Bridgeport and Norristown, one track on the bridge would be used by Conrail and one by the light rail cars.

Norristown Transportation Center and a new station with parking at Norristown East (Ford Street) would be the next

stations. Both Elm Street and Main Street stations on existing Route R6 would be eliminated. The existing Conshohocken, Spring Mill and Miquon stations would all serve the light rail line. At Ivy Ridge, the tracks of the former Reading and Pennsylvania Railroad would be joined, and light rail cars would stop at Ivy Ridge and Manayunk, then cross the river on the Ivy Ridge Branch to serve Barmouth, Cynwyd, Bala and Wynnefield Stations. The portion of the Route R6 Norristown Line between 16th Street Junction and Ivy Ridge would be abandoned, and express bus service would connect East Falls Station with Center City.

From Wynnefield, a new bridge would be constructed over Parkside Avenue. Trains would leave the R6 right-of-way via the new bridge and operate for about a mile on the abandoned right-of-way of the old Fairmount Park Transportation Co. to a point just west of Belmont Avenue. A station would be located at the Mann Music Center at 52nd Street, possibly with parking for commuters. A new tunnel would carry the trains under Belmont Avenue. They would then run alongside South Concourse Drive and exit onto Girard Avenue with the assistance of a traffic signal at a point just west of the Zoo. Trains would run in the middle of Girard Avenue, sharing dual-gauge trackage with Route 15, until they cross the river. There would be a station at the Zoo. Girard Avenue just east of the river crosses over a four-track freight branch of Conrail. Again with the assistance of a traffic signal, light rail trains would turn from Girard Avenue onto a ramp which would carry them down to the freight branch. This branch runs through a tunnel under Pennsylvania Avenue, where a station for the Art Museum would

be located. The line surfaces at the east end of Pennsylvania Avenue and runs in a cut just north of Callowhill Street, running under The Inquirer Building and Broad Street. A Franklintown station would be located at 17th Street, and another station would be on the east side of Broad Street. The line continues on private right-of-way until it joins the Northeast Metro at 12th and Noble Streets.

Trains would run south on 12th Street, with stops at the Convention Center and Market Street. At Chestnut Street, trains would turn west and operate on double-track in the bed of Chestnut Street to about 18th Street, with stops at 13th, 15th/16th and 17th/18th.

Ideally, an off-street terminal with four tracks would serve as the end of the line. The stub-end track on Chestnut Street with a double crossover, as shown on the accompanying map, is not a satisfactory terminal. This is an area that requires additional study.

Free transfers would be issued so that passengers from the Schuylkill Valley Metro wishing to go to points on Chestnut Street east of 12th Street could transfer to Northeast Metro trains, and vice versa.

A zonal fare system would be created on this line. The standard City Transit Division fare would be charged as far as Ivy Ridge. A second zone would extend to Conshohocken, a third zone to Abrams, and a fourth zone to the Route 422 terminus.

For its ultimate (Phase II) service level, the line would require 62 articulated cars, including spares.

It is estimated that the Schuylkill Valley Metro would carry 18,000 passengers daily, with revenue of \$7.8 million per year and operating costs of \$12.3 million per year. Construction costs are estimated at \$489 million. Tables showing these costs, as well as other data, appear in the appendix of this report.

Subway-Surface System

It is proposed that the five existing subway-surface lines-- Routes 10, 11, 13, 34 and 36--should remain in service, with additional cars, a short extension and some strategies to speed up running time.

A short extension would be constructed from Malvern Avenue to the inbound side of the Overbrook Station of Regional Rail Route R5, using 63rd Street. The existing Malvern Loop would be eliminated. This would provide connections between Route 10 and Route R5, and would particularly make reverse commuting easier for residents of West Philadelphia.

The existing fleet of Kawasaki light rail cars would be partially reallocated. Surface Route 15 would be fully equipped with these cars, and enough new cars would be purchased to allow for a 20 percent increase in existing service on each of the five subway-surface routes. Route 13, the heaviest of the five subway-surface routes, would be fully equipped with new articulated cars. Route 34 would also receive some articulated cars, operating with both articulateds and Kawasaki cars.

It is recommended that 33 articulated cars, including spares, be purchased for the subway-surface system. The reallocation of cars and the 20 percent service increase is easy to follow by referring to the Light Rail Vehicle Requirements table.

Surface Streetcar Routes

It is proposed that the entire PCC fleet be removed from service, and that Routes 23 and 56 be operated with buses on a permanent basis.

The old PCC fleet is expensive to maintain, is increasingly prone to mechanical failures and would need to be replaced in the near future. Routes 23 and 56 operate strictly on city streets, with no private right-of-way and no ability to operate the lines more rapidly than buses could operate. Route 23 operates on some particularly narrow and congested streets, which seriously affects its on-time performance on a regular basis.

These streetcar lines are more expensive to operate than bus routes, but they are incapable of offering speedier rides than buses and are more subject to traffic delays. And new streetcars, while they last two or three times as long as buses, are several times more expensive to purchase.

For these reasons, it is believed that Routes 23 and 56 should no longer be operated as streetcar routes, and that the additional cost of operating and maintaining them, and of purchasing new vehicles for them, could much better be utilized elsewhere.

It is recommended that Route 52, one of the heaviest surface transit routes in the SEPTA system, should be converted to light rail. Route 52 presently carries about 27,000 daily passengers, and with better service probably has the potential to carry even more. It is estimated that with frequent service using articulated light rail vehicles, ridership could climb to 35,000. While Route 52 operates in streets, its tremendous volume of passengers

justifies its conversion to light rail.

It is also recommended that Route 15 be retained as a light rail line, and that rail cars be given priority at traffic lights where feasible. It may be possible to provide exclusive lanes for light rail cars on portions of the eastern end of the route. On the west end, the route should be extended from its present terminus at 63rd Street and Girard Avenue northward to Overbrook Regional Rail Station. There would be no capital costs involved in this extension once Route 10 tracks are extended to the rail station.

It is recommended that articulated cars be purchased for Route 52 because of the passenger volume. A total of 22, including spares, would be required. Route 15 would receive 25 of the existing Kawasaki cars, and all PCC cars would be retired.

Historic Trolley Line

It may be desirable to institute an historic trolley route in the Chestnut Hill-Germantown area for use by tourists and shoppers.

The line could utilize a portion of the existing Route 23, from Chestnut Hill Loop to Germantown and Gorgas Avenue, where turning capability exists. Maintenance could be performed in a small section of the Germantown Depot. This rail line would be isolated from the balance of the light rail network, and would operate with 10 restored PCC cars. It may be feasible to operate the line only on weekends.

Cars could make all stops and carry regular passengers wishing to get around in Chestnut Hill, as well as serving as a tourist attraction. Chestnut Hill merchants could offer free rides to customers.

A second option for this line would be to offer the operation to the Penn's Landing Trolley Association, whose present operation on Delaware Avenue would be disrupted by the proposed Penn's Landing-Old City Loop.

APPENDIX A

NORTHEAST METRO

Mileage and Running Times Between Stations

Northbound from Center City to Byberry

Southbound from Byberry to Center City

Northbound from Center City to Fox Chase

Southbound from Fox Chase to Center City

Capital Cost Estimates

Guideway Construction Capital Costs

Parking and Station Construction Capital Costs

Capital Cost Summary

Annual Operating Expense and Revenue

Potential Operating Cost Savings Due to Bus and

Regional Rail Service Revisions

Travel Time Comparison: Northeast Metro vs. Present Service

NORTHEAST METRO

MILEAGE AND RUNNING TIME BETWEEN STATIONS

NORTHBOUND TO BYBERRY

STATION	MILES	MILES	LOCAL	LOCAL	EXPRESS	EXPRESS
	BY STOP	CUMULA- TIVE	MINUTES BY STOP	MINUTES CUMULA- TIVE	MINUTES BY STOP	MINUTES CUMULA- TIVE
10th & Chestnut	0.0	0.0	0	0	0	0
7th/8th & Chestnut	0.3	0.3	3	3	3	3
5th & Market	0.3	0.6	3	6	3	6
3rd & Willow	0.8	1.4	3	9	3	9
Spring Garden	0.4	1.8	2	11	2	11
American Street	2.2	4.0	4	15	4	15
Feltonville	1.9	5.9	3	18	NO STOP	NO STOP
Olney	1.7	7.6	3	21	NO STOP	NO STOP
Lawndale	1.3	8.9	2	23	NO STOP	NO STOP
Cheltenham	0.6	9.5	2	25	NO STOP	NO STOP
Ryers East	0.7	10.2	2	27	8	23
Rhawnhurst	1.0	11.2	2	29	2	25
Krewstown	1.8	13.0	3	32	3	28
Bustleton	1.2	14.2	2	34	2	30
Byberry	1.8	16.0	2	36	2	32

NORTHEAST METRO MILEAGE AND RUNNING TIME BETWEEN STATIONS

SOUTHBOUND TO CENTER CITY

STATION	MILES	MILES	LOCAL	LOCAL	EXPRESS	EXPRESS
	BY STOP	CUMULA- TIVE	MINUTES BY STOP	MINUTES CUMULA- TIVE	MINUTES BY STOP	MINUTES CUMULA- TIVE
Byberry	0	0.0	0	0	0	0
Bustleton	1.8	1.2	3	3	3	3
Krewstown	1.2	3.0	2	5	2	5
Rhawnhurst	1.8	4.0	3	8	3	8
Ryers East	1.0	4.7	2	10	2	10
Cheltenham	0.7	5.3	2	12	NO STOP	NO STOP
Lawndale	0.6	6.6	2	14	NO STOP	NO STOP
Olney	1.3	8.3	2	16	NO STOP	NO STOP
Feltonville	1.7	10.2	2	18	NO STOP	NO STOP
American Street	1.9	12.1	3	21	7	17
Spring Garden	2.2	14.3	6	27	6	23
3rd & Willow	0.4	14.7	2	29	2	25
Convention Center	1.1	15.8	3	32	3	28
South						
12th & Market	0.1	15.9	3	35	3	31
10th & Chestnut	0.3	16.2	3	38	3	34

NORTHEAST METRO MILEAGE AND RUNNING TIME BETWEEN STATIONS

NORTHBOUND TO FOX CHASE

STATION	MILES	MILES	LOCAL	LOCAL	EXPRESS	EXPRESS
	BY STOP	CUMULA- TIVE	MINUTES BY STOP	MINUTES CUMULA- TIVE	MINUTES BY STOP	MINUTES CUMULA- TIVE
10th & Chestnut	0.0	0.0	0	0		
7th/8th & Chestnut	0.3	0.3	3	3	N	N
5th & Market	0.3	0.6	3	6	O	O
3rd & Willow	0.8	1.4	3	9		
Spring Garden	0.4	1.8	2	11	E	E
American Street	2.2	4.0	4	15	X	X
Feltonville	1.9	5.9	3	18	P	P
Olney	1.7	7.6	3	21	R	R
Lawndale	1.3	8.9	2	23	E	E
Cheltenham	0.6	9.5	2	25	S	S
Ryers West	0.6	10.1	2	27	S	S
Fox Chase	1.0	11.1	2	29		

NORTHEAST METRO MILEAGE AND RUNNING TIME BETWEEN STATIONS

SOUTHBOUND TO CENTER CITY

STATION	MILES BY STOP	MILES CUMULA- TIVE	LOCAL MINUTES BY STOP	LOCAL MINUTES CUMULA- TIVE	EXPRESS MINUTES BY STOP	EXPRESS MINUTES CUMULA- TIVE
Fox Chase	0.0	0.0	0	0		
Ryers West	1.0	1.0	2	2	N	N
Cheltenham	0.6	1.6	2	4	O	O
Lawndale	0.6	2.2	2	6		
Olney	1.3	3.5	2	8	E	E
Feltonville	1.7	5.2	2	10	X	X
American Street	1.9	7.1	3	13	P	P
Spring Garden	2.2	9.3	6	19	R	R
3rd & Willow	0.4	9.7	2	21	E	E
Convention Center	1.1	10.8	3	24	S	S
South					S	S
12th & Market	0.1	10.9	3	27		
10th & Chestnut	0.3	11.2	3	30	3	#VALUE!

CAPITAL COST ESTIMATES

Cost estimates for the two proposed light rail lines were derived from the recently published "Light Rail Transit Capital Cost Study", an UMTA report which documents actual construction costs for the five most recently constructed light rail transit systems in the United States. Unit costs from this report were applied to the two proposed light rail lines to determine an approximate cost for their construction. Unit costs used in the estimates were given in the report according to the categories listed below, and were applied as follows:

A. Guideway Costs:

At-Grade, Existing Railroad ROW	\$ 350 per foot
New ROW	\$ 491 per foot
In pavement (ballasted)	\$ 526 per foot
In pavement (embedded)	\$1,452 per foot
Elevated Structure	\$2,746 per foot

B. Yards and Shop:

Lump sum of \$23,800,000.

C. Signal and Communications Systems:

\$482 per foot

D. Stations and Parking:

Station Costs

On-street	\$ 0.2 million
Elevated	\$ 2.6 million
Subway	\$16.0 million
At-grade	\$ 0.8 million
Below Grade	\$ 1.2 million

(For existing Regional Rail Stations \$100,000 was allocated to make modifications to achieve wheelchair accessibility and station improvements)

Parking Costs

(from recent SEPTA experience)

\$2,500 per space w/o land acquisition

Land acquisition costs vary based estimated value.

CAPITAL COST ESTIMATES

E. Vehicles:

The UMTA report uses an average of \$1.2 million each, however recent experience in purchasing articulated light rail vehicles which are desired for these lines is closer to \$2 million each.

F. Special Conditions:

(including utility relocations)
\$337 per foot

G. Right-of-Way and relocation costs:

\$346 per foot

H. Soft Costs:

Including Feasibility Studies, Environmental Studies, Engineering, Construction Management, Project Management Oversight.

51.8% of "In-Ground" Costs.

APPENDIX B
SCHUYLKILL VALLEY METRO

Mileage and Running Times Between Stations
Northbound from Center City to Route 422
Southbound from Route 422 to Center City

Capital Cost Estimates
Guideway Construction Capital Costs
Parking and Station Construction Capital Costs
Capital Cost Summary

Annual Operating Expense and Revenue
Potential Operating Cost Savings Due to Bus and
Regional Rail Service Revisions

Travel Time Comparison: Schuylkill Valley Metro vs.
Current Tansit Service

SCHUYLKILL VALLEY METRO

MILEAGE AND RUNNING TIME BETWEEN STATIONS

NORTHBOUND TO NORRISTOWN AND ROUTE 422

STATION	MILES BY STOP	MILES CUMULA- TIVE	LOCAL MINUTES BY STOP	LOCAL MINUTES CUMULA- TIVE	EXPRESS MINUTES BY STOP	EXPRESS MINUTES CUMULA- TIVE
17th/18th & Chestnut	0.0	0.0	0	0	0	0
15th/16th & Chestnut	0.2	0.2	2	2	2	2
13th & Chestnut	0.2	0.4	2	4	2	4
11th & Market	0.3	0.7	2	6	2	6
Convention Center	0.2	0.9	2	8	2	8
North						
Broad Street	0.8	1.7	2	10	2	10
Franklintown	0.4	2.1	2	12	2	12
Art Museum	0.8	2.9	2	14	2	14
Zoo	1.1	4.0	3	17	NO STOP	NO STOP
Music Center	1.6	5.6	2	19	NO STOP	NO STOP
Wynnefield	0.9	6.5	2	21	NO STOP	NO STOP
Bala	0.8	7.3	2	23	6	20
Cynwyd	0.4	7.7	2	25	NO STOP	NO STOP
Barmouth	0.7	8.4	2	27	NO STOP	NO STOP
Manayunk	1.0	9.4	2	29	NO STOP	NO STOP
Ivy Ridge	0.7	10.1	2	31	4	24
Miquon	2.3	12.4	3	34	3	27
Spring Mill	1.6	14.0	3	37	3	30
Conshohocken	1.2	15.2	2	39	2	32
Norristown East	3.1	18.3	4	43	4	36
Norristown T.C.	0.7	19.0	2	45	2	38
Abrams	1.9	20.9	3	48	3	41
Port Kennedy	2.4	23.3	3	51	3	44
Valley Forge	2.0	25.3	3	54	3	47
Perkiomen	1.7	27.0	3	57	3	50
Oaks	1.1	28.1	2	59	2	52
Route 422	1.0	29.1	2	61	2	54

SCHUYLKILL VALLEY METRO

MILEAGE AND RUNNING TIME BETWEEN STATIONS

SOUTHBOUND TO CENTER CITY

STATION	MILES BY STOP	MILES CUMULA- TIVE	LOCAL MINUTES BY STOP	LOCAL MINUTES CUMULA- TIVE	EXPRESS MINUTES BY STOP	EXPRESS MINUTES CUMULA- TIVE
Route 422	0.0	0.0	0	0	0	0
Oaks	1.0	1.0	2	2	2	2
Perkiomen	1.1	2.1	2	4	2	4
Valley Forge	1.7	3.8	3	7	3	7
Port Kennedy	2.0	5.8	3	10	3	10
Abrams	2.4	8.2	3	13	3	13
Norristown T.C.	1.9	10.1	3	16	3	16
Norristown East	0.7	10.8	2	18	2	18
Conshohocken	3.1	13.9	4	22	4	22
Spring Mill	1.2	15.1	2	24	2	24
Miquon	1.6	16.7	3	27	3	27
Ivy Ridge	2.3	19.0	3	30	3	30
Manayunk	0.7	19.7	2	32	NO STOP	NO STOP
Barmouth	1.0	20.7	2	34	NO STOP	NO STOP
Cynwyd	0.7	21.4	2	36	NO STOP	NO STOP
Bala	0.4	21.8	2	38	4	34
Wynnefield	0.8	22.6	2	40	NO STOP	NO STOP
Music Center	0.9	23.5	2	42	NO STOP	NO STOP
Zoo	1.6	25.1	2	44	NO STOP	NO STOP
Art Museum	1.1	26.2	3	47	6	40
Franklintown	0.8	27.0	2	49	2	42
Broad Street	0.4	27.4	2	51	2	44
Convention Center	0.8	28.2	2	53	2	46
South						
12th & Market	0.1	28.3	2	55	2	48
13th & Chestnut	0.3	28.6	2	57	2	50
15th/16th & Chestnut	0.2	28.8	2	59	2	52
17th/18th & Chestnut	0.2	29.0	2	61	2	54

CAPITAL COST ESTIMATES

Cost estimates for the two proposed light rail lines were derived from the recently published "Light Rail Transit Capital Cost Study", an UMTA report which documents actual construction costs for the five most recently constructed light rail transit systems in the United States. Unit costs from this report were applied to the two proposed light rail lines to determine an approximate cost for their construction. Unit costs used in the estimates were given in the report according to the categories listed below, and were applied as follows:

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Lump sum of \$23,800,000.

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On-street	\$ 0.2 million
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Subway	\$16.0 million
At-grade	\$ 0.8 million
Below Grade	\$ 1.2 million

(For existing Regional Rail Stations \$100,000 was allocated to make modifications to achieve wheelchair accessibility and station improvements)

Parking Costs

(from recent SEPTA experience)

\$2,500 per space w/o land acquisition

Land acquisition costs vary based estimated value.

CAPITAL COST ESTIMATES

E. Vehicles:

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F. Special Conditions:

(including utility relocations)
\$337 per foot

G. Right-of-Way and relocation costs:

\$346 per foot

H. Soft Costs:

Including Feasibility Studies, Environmental Studies, Engineering, Construction Management, Project Management Oversight.

51.8% of "In-Ground" Costs.

SCHUYLKILL VALLEY METRO CAPTIAL COST GUIDEWAY CONSTRUCTION

		COST PER MILE (millions) == >			\$2.55	\$1.78	\$1.83
		A			C	F	G
SECTION	DESCRIPTION	MILES	GUIDEWAY COST PER MILE (millions)	GUIDEWAY	SIGNAL AND COMMUNICATN. SYSTEMS	UTILITY RELOC. AND SPECIAL CONDITIONS	ACQUISITION OF RIGHT OF WAY
Route 422 Terminus to Upper Indian Head Road	Grade Separated ROW	0.30	\$2.60	\$780,000	\$765,000	\$534,000	\$549,000
Upper Indian Head Road	New Bridge over highway		\$0.00	\$4,000,000	\$0	\$0	\$0
Upper Indian Head Road to Route 422 Expressway East	Tunnel under highway & access	0.30	\$0.00	\$10,000,000	\$765,000	\$534,000	\$0
		0.10	\$2.60	\$260,000	\$255,000	\$178,000	\$0
Former CONRAIL Perkiomen Line between Route 422 Expwy and Egypt Road	ROW exists, discontinued	0.20	\$1.85	\$370,000	\$510,000	\$0	\$366,000
CONRAIL Perkiomen Line between Egypt Road and Schuylkill River Bridge	ROW exists upgrade to double track	0.80	\$5.30	\$4,240,000	\$2,040,000	\$0	\$1,464,000
CONRAIL Perkiomen Line between Schuylkill River Bridge and Perkiomen Junction	ROW exists upgrade to double track	0.70	\$5.30	\$3,710,000	\$1,785,000	\$0	\$1,281,000
CONRAIL Harrisburg Line between Perkiomen Junction and CP-Norris	Grade Separated ROW (existing)	7.30	\$1.85	\$13,505,000	\$18,615,000	\$0	\$13,359,000

SCHUYLKILL VALLEY METRO CAPTIAL COST GUIDEWAY CONSTRUCTION

SECTION	DESCRIPTION	MILES	COST PER MILE (millions) == >				
			A		C	F	G
			GUIDEWAY COST PER MILE (millions)	GUIDEWAY	SIGNAL AND COMMUNICATN. SYSTEMS	UTILITY RELOC. AND SPECIAL CONDITIONS	ACQUISITION OF RIGHT OF WAY
Connection to Route R6 between CP-Norris and Norristown T.C.	Bridge over Schuylkill River (existing)	0.80	\$1.85	\$1,480,000	\$2,040,000	\$0	\$1,464,000
Route R6 between Norristown T.C. and west of Ivy Ridge	Existing Railroad	9.00	\$0.00	\$0	\$22,950,000	\$0	\$0
Connection from existng Route R6 (RDG) to Route R6 Ivy Ridge Line (PC)	Rebuild bridge over Parker Avenue	0.20	\$2.60	\$520,000	\$510,000	\$356,000	\$0
Bridge over Schuylkill River	Rehabilitate Existing Bridge		\$0.00	\$15,000,000	\$0	\$0	\$0
Route R6 line between Ivy Ridge and Wynnefield	Existing Railroad	3.80	\$0.00	\$0	\$9,690,000	\$0	\$0
Connection from Route R6 to former Fairmount Park Trolley Private ROW	Bridge over Parkside Avenue	0.20	\$14.50	\$2,900,000	\$510,000	\$356,000	\$0
Former Fairmount Park Private Trolley ROW to 52nd Street	Private ROW tunnel under 52nd Street	0.40	\$1.85	\$740,000	\$1,020,000	\$712,000	\$0

SCHUYLKILL VALLEY METRO CAPTIAL COST GUIDEWAY CONSTRUCTION

SECTION	DESCRIPTION	MILES	COST PER MILE (millions) = = >				
			GUIDEWAY COST PER MILE (millions)	A	C	F	G
				GUIDEWAY	SIGNAL AND COMMUNICATN. SYSTEMS	UTILITY RELOC. AND SPECIAL CONDITIONS	ACQUISITION OF RIGHT OF WAY
Former Fairmount Park Trolley Private ROW between 52nd Street and 49th Street	Private ROW	0.40	\$1.85	\$740,000	\$1,020,000	\$712,000	\$0
Continue Private ROW adjacent to Parkside and Girard Avenue between 49th and 38th Streets	Private ROW with 4 grade crossings	1.00	\$2.60	\$2,600,000	\$2,550,000	\$1,780,000	\$0
Continue Private ROW adjacent to Parkside and Girard Avenue between 49th and 38th Streets	Private ROW with 4 grade crossings	1.00	\$2.60	\$2,600,000	\$2,550,000	\$1,780,000	\$0
Girard Avenue between between 38th and 31st Street	Dual Gauge, Center resevation ROW with Rt. 15	0.70	\$8.20	\$5,740,000	\$1,785,000	\$1,246,000	\$183,000
Ramp Down to CONRAIL City Branch	Grade Crossing at Girard Avenue	0.10	\$14.50	\$1,450,000	\$255,000	\$178,000	\$549,000
CONRAIL City Branch between Poplar and 27th Streets	Grade Separated Reserved ROW	0.30	\$1.85	\$555,000	\$765,000	\$534,000	\$915,000
CONRAIL City Branch between 27th and 21st Streets	Underground	0.50	\$1.85	\$925,000	\$1,275,000	\$0	\$1,098,000
CONRAIL City Branch between 21st and 15th Streets	Open Cut Reserved ROW	0.60	\$1.85	\$1,110,000	\$1,530,000	\$0	\$366,000

RANGE OF UNIT COSTS**EXHIBIT 5**

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
5.00 VEHICLES	<i>Each</i>	5	\$968,562	\$1,159,567	\$1,345,218	\$376,657
5.01 REVENUE VEHICLES -- ORDER A	<i>Each</i>	5	\$806,202	\$1,119,800	\$1,314,877	\$508,676
5.02 REVENUE VEHICLES -- ORDER B	<i>Each</i>	1	\$1,255,800	\$1,255,800	\$1,255,800	\$0
5.03 REVENUE VEHICLES -- ORDER C	<i>Each</i>					
5.04 NON-REVENUE VEHICLES	<i>Each</i>	2	\$11,267	\$48,750	\$86,232	\$74,965

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

dimensions. Special components such as cab signaling, air conditioning, wheelchair lifts, and the particular farebox system were denoted when included in each vehicle order -- otherwise the farebox costs were included in the systems cost category. Non-revenue vehicles were included as a separate category for service trucks, support automobiles and any other necessary non-revenue equipment.

This asset category had the most consistent unit cost experience for all five light rail systems. Exhibit 5 provides the unit cost summary for the vehicle category. Light rail vehicles had unit costs ranging from a low of \$800,000 to a high of \$1,300,000. These vehicles were all articulated with the main differences in the individual vehicle capability and componentry. The lowest unit cost vehicle order represents the most basic design criteria and the more recent order from this same system was at a much greater cost at over \$1.25 million each. Therefore, the higher unit cost range may be more representative than the low or average vehicle cost values.

Non-revenue vehicle costs varied significantly because of the different operational philosophies. Some systems procured all necessary non-revenue vehicles and others only purchased the minimum amount and contracted for the other support services. The unit cost range reflects these two developmental approaches with a minimum unit cost of \$11,000 for mainly automotive support vehicles and a maximum of \$86,000 each for a support fleet that also includes more heavy trucks and other support vehicles.

Special Conditions -- Development of a light rail system involves some mitigating construction requirements that are not directly related to rail service, but necessary to construct each rail line. The capital costs of these items have been included in this special conditions category. The largest cost component is the relocation of existing utility lines from or within the rail corridor under construction. These costs have been separated by replacements in the same or similar condition and replacement with improved or different utility conditions that was

RANGE OF UNIT COSTS**EXHIBIT 6**

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
6.00 SPECIAL CONDITIONS	<i>Linear feet</i>	5	\$81	\$337	\$1,263	\$1,182
6.01 UTILITY RELOCATION - AS IS	Total	5	\$2,524,684	\$4,719,422	\$6,370,239	\$3,845,555
6.02 UTILITY RELOCATION - BETMTS.	Total	3	\$495,549	\$41,497,095	\$118,409,923	\$117,914,373
6.03 UTILITY RELOCATION - OTHER	Total					
6.04 DEMOLITIONS	Total	5	\$112,628	\$511,718	\$956,912	\$844,284
6.05 ROADWAY CHANGES	Total	2	\$2,220,974	\$7,086,721	\$11,952,468	\$9,731,494
6.06 ENVIRONMENTAL	Total	3	\$356,640	\$6,349,686	\$16,785,885	\$16,429,246

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

denoted in the data base as betterments. These replacement costs were listed by utility:

- Gas;
- Telephone;
- Electric;
- Water;
- Pipeline;
- Railroad; and
- Other.

An additional section for utility replacement costs was provided for any unusual or unforeseen circumstances. Three more of these special condition categories were also included for demolitions, roadway changes, and environmental mitigation costs.

These special conditions were measured overall on a linear foot basis to provide a reasonable unit measure for use in planning other light rail systems. Exhibit 6 presents the unit cost summary of special conditions encountered in the development of these light rail systems. The total and unit costs varied significantly for this cost category and should therefore, be carefully considered in cost estimation applications. On a unit cost basis special conditions costs varied from a minimum of \$81 to a maximum of \$1,263 per linear foot, with a mean value of \$337 per linear foot. The total values per system were also provided for each individual cost category. When initial information is available about the extent of special conditions expected for the project, the total costs from the individual cost categories may be most useful, while in the absence of specific special conditions, the overall unit costs may be more appropriate. The lower unit costs may be more appropriate in less dense urban areas and the higher unit costs in more densely developed and/or mature urban areas.

Right-Of-Way - - This capital cost category covered all land acquisition and acquisition-related costs. Land acquisition costs were requested for direct purchases and estimated value for any land donations

RANGE OF UNIT COSTS**EXHIBIT 7**

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
7.00 RIGHT-OF-WAY	<i>Linear Feet</i>	5	\$160	\$346	\$600	\$440
7.01 LAND ACQUISITION - PURCHASED	Total	5	\$15,470,477	\$30,823,677	\$50,376,726	\$34,906,250
7.02 LAND ACQUISITION - DONATED	Total					
7.0 ACQUISITION-RELATED COST	Total	4	\$813,454	\$2,296,128	\$4,083,215	\$3,269,761
7.04 RELOCATION	Total	3	\$139,942	\$267,577	\$471,332	\$331,390
7.05 OTHER	Total					

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

or swaps. The related purchase costs for management, appraisal, and relocation expenses were also listed in this capital cost category. The original data was requested on an acreage basis by functional use -- mainline, stations, yards, and parking.

Similar to the special conditions, land costs are presented on a linear foot basis for the overall category costs and on a project total for the individual cost categories -- Exhibit 7. Overall right-of-way costs ranged from \$160 per linear foot to a high of \$600 per linear foot, with a mean of \$346. Land acquisition costs in total cost from \$15.5 million to as high as \$50.4 million. Land acquisition related costs followed a similar cost pattern ranging from \$800,000 to a high of \$4.1 million. Relocation costs were fairly small and only reported by three of the five systems.

Project Soft Costs - - This section included all other miscellaneous costs related to development of passenger rail services. The majority of these costs were expended in the planning, engineering, and project management efforts. These services included in-house agency staff and the use of consultants for particular tasks. Project start-up and initiation expenses were also included in this cost category. Project financing cost and an "other" expense line item which includes any reconciliations and unaccountable costs, comprise the full range of any project development capital costs.

Exhibit 8 highlights the unit cost summary of all project soft costs incurred in the development of these light rail systems. This capital cost category represents a fairly large expenditure commitment for light rail system development. The wide cost range is some indication of the relative complexity of each system and the extent of professional services necessary for system development. The cost measurement of in-house agency staff support may not be fully represented and possibly an indication of the cost variance among the individual categories and overall project soft costs. The other expense line item included some reconciliation account costs and some other unidentified expenses.

RANGE OF UNIT COSTS**EXHIBIT 8**

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
8.00 SOFT-COSTS	Linear Feet	5	\$359	\$1,491	\$3,068	\$2,708
8.01 FEASIBILITY STUDIES	Total	3	\$3,718,000	\$14,612,295	\$36,398,671	\$32,680,671
8.02 ENGINEERING & DESIGN	Total	3	\$16,009,645	\$48,230,137	\$68,801,392	\$52,791,747
8.03 CONSTRUCTION MANAGEMENT	Total	5	\$4,788,081	\$35,548,854	\$85,158,669	\$80,370,588
8.04 PROJECT MANAGEMENT	Total	5	\$2,173,544	\$14,678,448	\$22,938,149	\$20,764,605
8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$4,539,183	\$4,539,183	\$4,539,183	\$0
8.06 PROJECT INITIATION	Total	3	\$1,319,808	\$14,136,884	\$35,235,765	\$35,235,765
8.07 FINANCE CHARGES	Total	1	\$546,621	\$546,621	\$546,621	\$0
8.08 TRAINING/START-UP/TESTING	Total	4	\$3,543,743	\$6,480,866	\$9,803,185	\$6,259,441
8.09 OTHER	Total	2	(\$16,589,228)	\$40,319,705	\$97,228,639	\$113,817,867

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

Exhibit 10
Summary Costs and Percentages of "As Built" Project Costs By Category
(Current \$ millions)

	<u>Portland</u>		<u>Sacramento</u>		<u>San Jose</u>		<u>Pittsburgh</u>		<u>Los Angeles</u>		<u>Average</u>	
Guideway Elements	\$94.6	57.9%	\$46.7	42.5%	\$65.9	35.0%	\$110.5	40.4%	\$148.7	25.4%	\$93.3	40.2%
Yards & Shops	\$11.6	7.1%	\$4.0	3.6%	\$21.3	11.3%	\$38.2	14.0%	\$44.2	7.5%	\$23.9	8.7%
Systems	\$21.2	13.0%	\$19.4	17.7%	\$33.1	17.6%	\$58.9	21.5%	\$115.3	19.7%	\$49.6	17.9%
Stallions	\$15.1	9.3%	\$10.3	9.3%	\$4.9	2.6%	\$34.3	12.5%	\$65.9	11.2%	\$26.1	9.0%
Special Conditions	\$5.8	3.5%	\$12.2	11.1%	\$8.5	4.5%	\$10.0	3.7%	\$152.3	26.0%	\$37.8	9.7%
Right-of-Way	\$15.1	9.2%	\$17.4	15.8%	\$54.6	29.0%	\$21.5	7.9%	\$60.1	10.2%	\$33.7	14.4%
Total "In-Ground" Costs	\$163.4	100.0%	\$110.0	100.0%	\$188.3	100.0%	\$273.4	100.0%	\$586.5	100.0%	\$264.3	100.0%
Vehicles as Percent of "In-Ground" Costs	\$25.2	15.4%	\$34.6	31.6%	\$55.6	29.6%	\$57.4	21.0%	\$79.9	13.6%	\$50.5	22.2%
Soft Costs as Percent of "In-Ground" Costs	\$58.3	35.7%	\$36.2	32.9%	\$136.4	72.4%	\$224.8	82.2%	\$210.8	35.9%	\$133.3	51.8%

SCHUYLKILL VALLEY METRO CAPTIAL COST GUIDEWAY CONSTRUCTION

SECTION	DESCRIPTION	MILES	COST PER MILE (millions) = = >		\$2.55	\$1.78	\$1.83
			GUIDEWAY COST PER MILE (millions)	GUIDEWAY	C	F	G
					SIGNAL AND COMMUNICATN. SYSTEMS	UTILITY RELOC. AND SPECIAL CONDITIONS	ACQUISITION OF RIGHT OF WAY
CONRAIL City Branch between 15th and Juniper Streets	Underground	0.20	\$1.85	\$370,000	\$510,000	\$0	\$183,000
CONRAIL City Branch between Juniper and 13th Streets	Private ROW and Bridge over 13th St.	0.10	\$1.85	\$185,000	\$255,000	\$0	\$0
Noble Street between 13th and 12th Streets	Grade Separated (ramp down)	0.20	\$14.50	\$2,900,000	\$510,000	\$356,000	\$0
Noble Street between 11th and 12th Streets	In Street	0.10	\$3.10	\$310,000	\$255,000	\$178,000	\$0
12th Street between Noble and Chestnut Streets	In Street	0.70	\$3.10	\$2,170,000	\$1,785,000	\$1,246,000	\$0
11th Street between Chestnut and Noble Streets	In Street	0.70	\$3.10	\$2,170,000	\$1,785,000	\$1,246,000	\$0
Chestnut Street between 11th and 18th Streets	In Street	0.50	\$7.60	\$3,800,000	\$1,275,000	\$890,000	\$0
SUBTOTAL				\$85,130,000	\$79,560,000	\$12,816,000	\$21,777,000
TOTAL (Items A, C, F and G)	\$199,283,000						

SCHYULKILL VALLEY METRO

CAPTIAL COST

PARKING AND STATION CONSTRUCTION

STATION	DESCRIPTION	COSTS PROPOSED STATION	COSTS PROPOSED PARKING	EXISTING PARKING SPACES	ADDITIONAL PARKING SPACES
Route 422	At-Grade Station	\$800,000	\$7,500,000	n/a	2,500
Oaks	At-Grade Station	\$800,000	\$3,750,000	n/a	1,000
Perkiomen	On-Fill Station	\$1,200,000	\$7,150,000	n/a	2,200
Valley Forge	Former RRD Station	\$100,000	\$0	n/a	0
Port Kennedy	Former RRD Station	\$100,000	\$387,500	n/a	130
Abrams	At-Grade Station	\$800,000	\$4,500,000	n/a	1,500
Norristown T.C.	Existing RRD Station	\$0	\$1,000,000	165	565
Norristown East	At-Grade Station	\$800,000	\$420,000	n/a	150
Conshohocken	Existing RRD Station	\$100,000	\$568,800	80	255
Spring Mill (M)	Existing RRD Station	\$100,000	\$0	20	90
Miquon	Existing RRD Station	\$100,000	\$0	60	0
Ivy Ridge	Existing RRD Station	\$100,000	\$375,000	210	310
Manayunk	Existing RRD Station	\$100,000	\$0	0	100
Barmouth	Existing RRD Station	\$100,000	\$62,500	25	0
Cynwyd (L)	Existing RRD Station	\$100,000	\$0	25	70
Bala	Existing RRD Station	\$100,000	\$0	60	0
Wynnefield	Existing RRD Station	\$100,000	\$0	0	0
Music Center	At-Grade	\$800,000	\$0	125	0
Zoo	At-Grade	\$800,000	\$0	n/a	n/a
Art Museum	Underground Station	\$16,000,000	\$0	n/a	n/a
Franklintown	Below Grade Station	\$1,200,000	\$0	n/a	n/a

SCHYULKILL VALLEY METRO

CAPTIAL COST

PARKING AND STATION CONSTRUCTION

STATION	DESCRIPTION	COSTS PROPOSED STATION	COSTS PROPOSED PARKING	EXISTING PARKING SPACES	PROPOSED PARKING SPACES
Broad Street	Underground Station	\$16,000,000	\$0	n/a	n/a
Convention Center South	On-Street	\$800,000	\$0	n/a	n/a
Convention Center North	On-Street	\$800,000	\$0	n/a	n/a
12th & Market	On-Street	\$800,000	\$0	n/a	n/a
11th & Market	On-Street	\$800,000	\$0	n/a	n/a
13th & Chestnut	On-Street	\$800,000	\$0	n/a	n/a
15th/16th & Chestnut	On-Street	\$800,000	\$0	n/a	n/a
17th/18th & Chestnut	On-Street	\$800,000	\$0	n/a	n/a
GRAND TOTAL		\$45,900,000	\$25,713,800	770	8,870

NOTE: (M) Montgomery County proposes to create parking for 70 cars on an adjacent lot.
 (L) Potential lease agreement with Lower Merion Township.

SCHUYLKILL VALLEY METRO CAPITAL COSTS SUMMARY

DESCRIPTION	COSTS
Guideway (A)	\$ 85,130,000
Signal and Communications (C)	\$ 79,560,000
Utility Relocation and Special Conditions (F)	\$ 12,816,000
Aquisition of Right of Way (G)	\$ 21,777,000
SUBTOTAL (Guideway Construction Items A, C, F and G)	\$199,283,000
Storage Yards and Maintenance Facility (B)	\$ 23,800,000
Parking and Stations (D)	\$ 71,614,000
Soft-Costs {H} (51.8% of Items A, B, C, D, F and G)	\$128,876,000
New Articulated Vehicles [201] at \$2,000,000 each	\$111,600,000
GRAND TOTAL	\$535,173,000

**SCHUYLKILL VALLEY METRO
ANNUAL OPERATING EXPENSE AND REVENUE**

OPERATING EXPENSE

Operating Expense is calculated using a three variable method as required by the Federal Transit Administration. Milage Expense includes vehicle maintenance and propulsion power, Wage Expense (vehicle hours) includes operator wages and fringes, and Peak Vehicle Expense includes fixed overhead for facilities, general overhead, and claims expense.

MILEAGE EXPENSE

8500 Car Miles Per Weekday (estimated)

5500 Car Miles Per Weekend (estimated)

Annual Car Miles = 2,173,000 X \$2.00 = \$4,345,000

OPERATOR WAGE EXPENSE

335 Work Hours Per Weekday

225 Work Hours Per Weekend

1.1 Pay Hours/Work Hour

107,300 Annual Pay Hours x \$24/Hour = \$ 2,575,000

PEAK VEHICLE EXPENSE

54 Cars x \$100,000 = \$5,400,000

ANNUAL OPERATING EXPENSE = \$12,320,000

ANNUAL REVENUE

18,000 Weekday Riders x \$1.50 Average Fare = \$ 27,000

12,000 Weekend Riders x \$1.50 Average Fare = \$ 18,000

ANNUAL REVENUE = \$7,857,000

OPERATING RATIO 63.7%

POTENTIAL OPERATING COST SAVINGS
BUS AND REGIONAL RAIL SERVICE REVISIONS
SCHUYLKILL VALLEY METRO

ROUTE	CURRENT COST	% SAVINGS	COST SAVINGS
9	\$ 3,844,00	15	\$ 500,000
27	\$ 3,985,000	15	\$ 598,000
38	\$ 2,302,000	10	\$ 230,000
44	\$ 2,717,000	50	\$ 1,358,000
61 Express	\$ 100,000	100	\$ 100,000
121	\$ 858,500	50	\$ 429,000
R6 Norristown	\$ 8,592,000	100	\$ 8,592,000
R6 Cynwyd	<u>\$ 2,485,000</u>	100	<u>\$ 2,485,000</u>
TOTAL	\$24,883,500		\$14,292,000

**TRAVEL TIME COMPARISON
TO CENTER CITY (12TH AND MARKET
OR MARKET EAST STATION)**

**SCHUYLKILL VALLEY METRO VERSUS CURRENT
TRANSIT SERVICE**

<u>STATION</u>	<u>PRESENT TRAVEL TIME (minutes)</u>	<u>VIA ROUTES</u>	<u>FUTURE TRAVEL TIME (minutes)</u>
Oaks	82	98 and R6	46 *
Valley Forge	75	99 and 125	41 *
Port Kennedy	75	125	38 *
Norristown T.C.	41	R6	32 *
Conshohocken	35	R6	26 *
Spring Mill	31	R6	24 *
Miguon	28	R6	21 *
Ivy Ridge	22	R6	18 *
Manayunk	20	R6	23
Cynwyd	28	R6	23
Bala	27	R6	14 *
Wynnefield Avenue	26	R6	15
Zoo	22	38	11

* - Travel Times are shown for peak period express service where existing or proposed.

APPENDIX C
SUBWAY SURFACE SYSTEM AND CITY
SURFACE LINES

**ROUTES 10 AND 15 EXTENSION
TO OVERBROOK RR STATION**

A. Guideway (In Street)

3.1 million per mile x 0.5 miles = \$1.55 million

C. Signal and Communication Systems

\$2.55 million per mile x 0.5 miles = \$1.3 million

F. Utility Relocation and Special Conditions

\$1.78 million per mile x 0.5 miles = \$0.9 million

TOTAL CAPITAL COST

\$3.75 million

ROUTE 52 CONVERSION TO LIGHT RAIL

Capital Cost of Guideway Construction

A. Guideway (In Street)

3.1 million per mile x 5.3 miles = \$16.5 million

C. Signal and Communication Systems

\$2.55 million per mile x 5.3 miles = \$13.5 million

F. Utility Relocation and Special Conditions

\$1.78 million per mile x 5.3 miles = \$ 9.4 million

E. Vehicles

\$1.8 million x 22 cars (19+3 spares)= \$41.8 million

TOTAL CAPITAL COST

\$83.4 million

APPENDIX D

**PREVIOUSLY PLANNED CAPITAL EXPENDITURES
(1992-2001)**

The following projects are contained in SEPTA's current ten year plan for capital projects and would either no longer be required, or are included in the proposed Light Rail Plan.

PROJECT TITLE	COST
Norristown Branch Track Renewal and Signal System Modernization	\$45 million
Regional Rail Service Extension to Pottstown	\$15 million
Regional Rail Service Extension via Stoney Creek Branch	\$10 million
Regional Rail Service Restoration to Ivy Ridge	\$15 million
Light Rail Vehicle Purchase	\$126 million *
Regional Rail Car Procurement	\$170 million
TOTAL	\$330 million

- * - This item is shown for \$75 million in the Capital Program, but current thinking is to purchase 70 Articulated Light Rail Cars (at approximately \$1.8 million each) for the Subway-Surface Lines and reassign part of the current LRV fleet to the North Philadelphia lines.

APPENDIX E

LIGHT RAIL VEHICLE REQUIREMENTS

ROUTE	CURRENT REQUIREMENT	PROPOSED REQUIREMENT	
		Kawasaki	Articulated
10	14	17	--
11	16	19	--
13	24	--	20
34	20	10	8
36	17	20	--
15	--	22	--
52	--	--	19
Extensions to 10 and 15	--	3	--
Northeast Metro	--	--	78
Schuylkill Valley Metro	--	--	54
Penn's Landing - Old City Loop	--	--	2
Subtotals	91	91	181
15% Spare Ratio	14	14	28
TOTALS	105	105	209

APPENDIX F

AFFECT ON REGIONAL RAIL ROSTER

<u>ROUTE</u>	<u>LINE</u>	<u>CARS MADE AVAILABLE</u>
R6	Norristown and Ivy Ridge	13
R8	Fox Chase	9
TOTAL		22

Appendix G

Population Data for Proposed Light Rail Corridors

The attached figure and corresponding tables reflect the population and the employment along the two proposed light rail corridors, one extending to northeast Philadelphia, the other through the northwest section of the city to Montgomery County. Both routes are shown here with a common loop alignment through Center city Philadelphia.

The data presented here is shown for the City of Philadelphia only. The "zones" shown in Tables 1 to 3 refer to DVRPC's geographic areas used in keeping data for modelling purposes. There is in most cases a one to one correspondence with the U.S. Census tracts and blocks.

While the data presented here is somewhat useful for examining the two alignments' ridership potential, its limitations are as follows:

1. Census tracts are not always appropriately "sized" to the geographic dimensions of the areas which could use the service. Singular or combined census tracts rarely correspond to the areas which one might consider the commuter or ridership shed.

2. Both the employment and population data are best regarded as approximate. The City of Philadelphia has challenged the census' population counts (with no success). The employment data is based upon the Bureau of Labor Statistics which does not cover those residents who are self employed. While the statistics have their limitations, they are the best that are available at this time.

Accurately estimating ridership on any new transit service is more art than science even with reliable and compatible population and employment data. At the current level of route feasibility analysis, a full modeling effort is not yet warranted.

TABLE 1*
1990 POPULATION AND EMPLOYMENT FOR
AREAS ADJACENT TO NORTHWEST RAIL PROPOSAL
POPULATION AND EMPLOYMENT

TRACT #	ZONE	POPULATION	EMPLOYMENT
134	186	5401	2252
136	188	5882	935
137	189	6573	934
110	161	4591	600
111	162	5333	2060
119	170	6302	484
120	171	1781	482
121	172	3007	976
214	273	3867	962
215	274	3542	1541
216	275	1464	965
219	278	1404	516
220	279	1600	666
TOTAL		50747	13373

TABLE 2*
1990 POPULATION AND EMPLOYMENT FOR
AREAS ADJACENT TO PROPOSED RAIL WITHIN CENTER CITY

TRACT #	ZONE	POPULATION	EMPLOYMENT
1	16	55	14431
	17	219	12170
	49	211	2131
	50	746	8451
	51	105	6599
10	18	2636	7618
	19	1320	11518
	20	1029	1734
	52	549	1951
16	58	100	1247
TOTAL		6970	67850

* Employment data from DVRPC
Population data from Philadelphia City Planning
Commission based on the 1990 Census

TABLE 3*
1990 POPULATION AND EMPLOYMENT FOR
AREAS ADJACENT TO NORTHEAST RAIL PROPOSAL

TRACT #	ZONE	POPULATION	EMPLOYMENT
142	194	2190	3132
144	198	3331	2104
156	210	2386	903
157	211	2764	2648
162	217	2858	323
163	218	4147	3261
176	231	11464	1982
195	254	8707	1982
196	255	2639	1790
287	346	2468	2533
288	347	3853	807
286	345	7114	982
274	333	9620	1816
277	336	5358	340
291	350	4461	2485
304	364	631	12875
303	363	6947	1962
309	369	3278	163
310	370	5636	1033
338	401	5461	1541
337	400	9025	2233
343	406	168	40
345	408	7947	1572
355	417	6953	3508
360	422	3061	6087
364	426	547	1597
164	219	5589	2660
175	230	9010	856
199	258	5390	1287
198	257	6966	1335
197	256	7739	7040
290	349	5670	510
308	368	4403	411
306	366	6518	1697
335	398	3400	1519
336	399	6148	765
TOTAL		183847	77779

* Employment data from DVRPC
Population data from Philadelphia City Planning
Commission based on the 1990 Census



NORTHEASTERN ALIGNMENT	
NORTHWESTERN ALIGNMENT	
CENTER CITY LOOP	

1990
PHILADELPHIA CENSUS TRACT

G 5

APPENDIX H
EXCERPTS FROM LIGHT RAIL TRANSIT
CAPTIAL COSTS STUDY

UMTA-MD-08-7001

April 5, 1991



U.S. Department
of Transportation

Urban Mass
Transportation
Administration

Light Rail Transit Capital Cost Study

UMTA-MD-08-7001

April 5, 1991



UMTA Technical Assistance and Safety Program
Office of Technical Assistance and Safety

INTRODUCTION

This report presents the results of the study to document actual construction and related developmental costs for the most recently-constructed light rail transit systems in the United States. With the successful opening of the San Diego Trolley in 1981, other U S cities have followed with the development of their own light rail systems. Through the decade of the 1980's, a total of seven light rail systems were constructed or significantly reconstructed.

- San Diego inaugurated initial line service in 1981;
- Buffalo began service in 1985;
- Portland opened service in 1986;
- Sacramento initiated service in 1987;
- San Jose opened their first segment in 1987;
- Los Angeles initiated service (1990) to Long Beach; and,
- Pittsburgh reopened service on their line in 1988.

These new light rail systems represent an important investment of public funds in the passenger transportation industry. The documentation of the actual component capital costs of these systems represents an opportunity to help prepare realistic capital cost estimates in the planning and engineering of the next set of systems.

This project has been sponsored by UMTA, of the U. S. Department of Transportation to document the actual construction and procurement costs of all component assets and related developmental costs for each system. The study objectives included an examination of unit cost characteristics that could be pertinent to the planning of similar systems, such as the distribution of costs by component categories, consistent unit cost ranges, and commonalities of component types and capacity requirements for a light rail system. The Office of Technical Assistance and Safety, Capital Development Division directed the study with the assistance of the Office of Grants Management Planning Analysis and Support Division.

This fixed guideway capital cost study is intended to provide a data base of actual unit costs for the various asset components used in the construction of light rail transit systems. The transit authorities operating these recently-completed light rail systems supplied the basic component cost data and then examined the translation of their cost data into the reporting structure for interpretational consistency. The resulting component cost information is intended to assist agencies in the planning and engineering stages to better prepare capital cost estimates for proposed new systems or lines.

This study and resulting report did not attempt to evaluate or explain the unit cost variances among the systems or the effectiveness of component type and capacity decisions. There are many reasons for these differences that reach beyond the analytical scope and objectives of this study. The size of this study sample did not support the establishment of statistically significant norms or variances in each of the cost categories. This was likely due to the unique characteristics of each system that exceed standard unit cost and capacity calculations. This report should not be construed as a follow-up to the UMTA Report "Urban Rail Transit Projects: Forecast Versus Actual Ridership And Costs". There was no explicit or implied effort to prepare any cost effectiveness comparisons of these systems. In addition, no attempt was made to critique the planning, engineering, procurement, construction management and construction cost incurred in the development of each system.

STATEMENT OF PURPOSE

Introduction

This fixed guideway capital cost study represents the first in a series of studies to examine the actual costs of major transit capital investments. This report presents the results of the first task to focus on the recent light rail projects that have been developed during the 1980's. Following studies will utilize this basic analysis structure and apply it to the other transit fixed guideway modes that have been implemented recently.

The information presented in this report should be used in line with the objectives posed for the study. The range of component unit costs should not be confused with any measures of efficiency since there remain other cost sensitive factors that lie outside those measured here. Further, the basic design philosophy of each system will directly affect unit and total costs. For example, some systems adopt a minimum cost design approach while others add amenities to attract higher market share. Station designs are a good example of these different developmental approaches. These effects on unit and total component costs do not easily conform to the quantitative focus of this study.

The component cost ranges produced in this report should provide a test for reasonableness of planning-level capital cost estimates and some guidance on the number and type of assets required for a light rail project. The cost ranges could also be used as a measure of project complexity and overall service levels and passenger carrying capacity -- the more complex and/or greater ridership demand, the more likely the project costs would tend toward the higher end of each component cost range. In addition, site conditions and interpretational provisions will have some direct effect upon the unit cost results. These effects should all be considered with the use of the information presented in this report.

Background

Capital cost estimates are key ingredients in determining the cost effectiveness, financial capacity and overall engineering feasibility of major capital investments. Fixed guideway transit systems, which involve Federal funding are developed in accordance with the Major Capital Investment Policy. This policy established a structured decision-making process that requires the careful development of costs, benefits and impacts of proposed systems. Reliable capital cost estimates are an important element of the investment decision process. The project development study process for major capital investments includes system planning, alternatives analysis and preliminary engineering. Since capital cost estimates are key ingredients to the decisions reached in each of the project study phases, the results of this study are intended to help guide the preparation of these capital costs through the availability of pertinent unit cost information and the typical asset requirements of a fixed guideway transit project.

An important aspect of the cost estimation procedures is the development of "Composite Unit Costs for Sections and Stations." The purpose of this study is to improve the accuracy and comparative compatibility of the capital cost estimates of the various systems under study. The benefit to the industry is the opportunity to check the reasonableness of planning-level cost estimates with the actual experience of building similar systems nationwide.

Good methods and reliable cost information are particularly important when comparing cost effectiveness and financial impacts among alternative capital investment projects. These comparisons require cost information that is compatible among alternative investments and reasonably in line with actual construction and procurement costs of each proposed system under study. More certainty of cost estimates and less variation to actual costs is more critical given the limited governmental

funding capacity and the expanded funding demand posed by the increased number of new systems requesting these capital funds.

In the recent past, preliminary capital cost estimates have often underestimated the actual costs and possibly blurred the alternative cost effectiveness decision. More importantly, underestimated capital costs have in the past stretched project financing plans, since required contributions from each funding source increased upon implementation -- sometimes beyond the capacity of certain funding mechanisms. On the Federal side, funding priorities were necessary to accommodate project cost increases, which sometimes led to decreased or delayed funding elsewhere. State and local funding sources were less able to directly absorb capital cost increases, leading to more difficult funding decisions.

The differences between planning estimates and actual construction cost results often include other impacts of ongoing project development, such as:

- Changes in the scope of the project;
- Changes in design standards;
- Unforeseen complexities in field conditions;
- Expanded environmental & community responsibilities; and
- Difficulties in implementation.

The sum of these cost impacts, coupled with the underestimation of unit costs and omission of some asset requirements, identifies most of the causes behind the underestimation of capital costs. A data base of actual project experiences on quantities and unit costs for major capital investments should help improve the degree of confidence in planning-level capital cost estimates.

Objectives

The size and complexity of the issues behind the underestimation of planning-level capital cost estimates required a careful review of causal

factors. The technical analysis was focused on where the most benefit could be achieved from an examination of actual project development experience. The objectives of the study were then defined as:

- To provide UMTA with the unit cost information to check the reasonableness of the capital cost estimates for major capital projects at the various stages of development;
- To provide local and state transportation planning agencies and consultants with experience-based cost information that could be used in generating more accurate and consistent capital cost estimates; and
- To reduce some of the original data collection effort needed to generate unit capital cost data for each study.

These objectives were then used to guide the study in the documentation and analysis of actual capital costs of five recent light rail transit projects.

Exhibit 1 presents the summary of guideway costs which represented on average, 33% of total project costs, exclusive of the planning/engineering/developmental type soft costs. This summary of actual guideway unit costs presents the number of data entries or observations for each guideway element, plus the minimum, mean, maximum, and range of unit cost values. The unit costs presented in this summary represent the constant dollar values in 1990 dollars, calculated from the original construction cost and year of construction, and then normalized to the nationwide comparative standard using the *Means* construction cost indices.

Guideway element costs in total, ranged from a minimum of \$428 per linear foot to a maximum of \$1,508 per linear foot. This leads to a wide cost range of over \$1,000, which illustrates the extensive cost variation from a mainly single track at-grade alignment to the more sophisticated, higher service volume systems that include mainly grade separated and some subway alignment. The mean or average guideway cost of \$1,016 per linear foot is pertinent if the planned alignment is not sufficiently defined to select one of the more specific unit cost values. The lowest cost guideway was the ballasted track type on an at-grade alignment, while the highest expense guideway was as expected, the direct fixation track type in a subway alignment. The unit cost details are also provided to summarize the individual unit cost information as calculated from the original actual costs submitted by each agency.

Yards and Shops - - Maintenance of the rail system components requires specialty shops for each major asset category. Unit costs were requested for each shop and particular system support function. In cases where system development was more complex, detailed cost information was available by shop; however, in some systems, yard and shop construction was contracted out as a "package" and cost information was only available at a summary level. The capital cost information request included fourteen yard and shop areas that encompassed the full range of system support needs. Flexibility was designed into the request to accommodate both detailed and summary level responses.

RANGE OF UNIT COSTS

EXHIBIT 1

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
1.00 GUIDEWAY ELEMENTS	Linear Feet	5	\$428	\$1,016	\$1,508	\$1,079
1.01 GUIDEWAY AT-GRADE	Linear Feet	5	\$413	\$665	\$1,205	\$792
DIRECT FIXATION		1	\$696	\$696	\$696	\$0
BALLASTED		5	\$350	\$491	\$679	\$329
IN-PAVEMENT BALLASTED		2	\$526	\$1,557	\$2,588	\$2,062
EMBEDDED		4	\$583	\$1,452	\$3,714	\$3,131
1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	4	\$410	\$1,768	\$3,041	\$2,631
DIRECT FIXATION		3	\$410	\$1,233	\$2,756	\$2,346
BALLASTED		3	\$1,119	\$2,746	\$4,516	\$3,397
IN-PAVEMENT BALLASTED						
EMBEDDED		2	\$506	\$1,936	\$3,365	\$2,859
1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	2	\$847	\$1,009	\$1,172	\$325
DIRECT FIXATION						
BALLASTED		2	\$847	\$1,009	\$1,172	\$325
IN-PAVEMENT BALLASTED						
EMBEDDED						
1.04 GUIDEWAY - ELEVATED FILL	Linear Feet	1	\$616	\$616	\$616	\$0
DIRECT FIXATION						
BALLASTED		1	\$616	\$616	\$616	\$0
IN-PAVEMENT BALLASTED						
EMBEDDED						
1.05 GUIDEWAY - SUBWAY	Linear Feet	2	\$6,329	\$7,443	\$8,557	\$2,228
DIRECT FIXATION		2	\$6,329	\$13,530	\$20,730	
BALLASTED						
IN-PAVEMENT BALLASTED		1	\$4,730	\$4,730	\$4,730	(\$0)
EMBEDDED		1	\$506	\$506	\$506	\$0
1.06 GUIDEWAY - RETAINED CUT	Linear Feet	3	\$329	\$3,354	\$5,410	\$5,081
DIRECT FIXATION						
BALLASTED		2	\$329	\$2,870	\$5,410	\$5,081
IN-PAVEMENT BALLASTED						
EMBEDDED						
1.07 POCKET TRACK	L.F. Guideway	2	\$2.81	\$34.11	\$65.41	\$62.61
1.08 STORAGE TRACK	L.F. Guideway					
1.09 SPECIAL TRACKWORK	L.F. Guideway	4	\$15.71	\$25.02	\$35.32	\$19.60
1.10 GUIDEWAY-SPECIAL STRUCTURES	Linear Feet	1	\$4,389	\$4,389	\$4,389	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

Exhibit 2 presents the unit cost summary for yards and shops components. The overall total category costs varied significantly from a minimum of about \$4.1 million to a high of \$42.8 million. This extremely wide cost range demonstrates that there are many factors affecting the cost of light rail yards and shops. The extent of maintenance facility and shop equipment requirements are at least partially driven by system design, capacity and complexity decisions. However, even when the yard and shop costs were measured on a guideway length or revenue vehicle unit cost basis, there was only a minor direct cost relationship to either unit cost measure. This yards and shops component cost information should therefore, be carefully applied in any planning level capital cost efforts, since there appeared to be little direct cost relationship among the standard unit capacity measures. The more detailed line item information about the 14 individual shop categories did not provide any better unit cost support, since the breakout of the cost information was very inconsistent. Therefore, these individual shop costs should only be used as an indication of prior actual experience.

System Elements - - The system needs were clearly defined by asset component and within four general functional categories.

- Signal system;
- Electrification;
- Communications; and
- Fare collection.

Capital cost information was normally available for each functional category, since these components are typically procured and/or installed through separate contracts.

As demonstrated in Exhibit 3, systems costs are somewhat more predictable and related overall, to the linear feet of each system. Systems costs ranged from \$179 per linear foot to a maximum of \$878 per linear foot. This cost range is indicative of the level of systems sophistication

RANGE OF UNIT COSTS

EXHIBIT 2

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
2.00 YARDS & SHOPS	Total	5	\$4,086,783	\$23,862,435	\$42,837,570	\$38,750,787
2.01 BUILDING	Each	5	\$4,086,783	\$17,019,418	\$36,002,375	\$31,915,592
2.02 OFFICE FURNITURE & EQUIP.	All	1	\$252,440	\$252,440	\$252,440	\$0
2.03 HEAVY REPAIR		3	\$69,070	\$349,318	\$731,367	\$662,297
2.04 MOTOR SHOPS		2	\$11,512	\$27,032	\$42,553	\$31,042
2.05 WHEEL SHOP		3	\$25,532	\$614,629	\$1,040,170	\$1,014,638
2.06 MACHINE SHOP		2	\$236	\$118,112	\$235,988	\$235,752
2.07 AIR CONDITIONING	(Y/N)	1	\$2,419,865	\$2,419,865	\$2,419,865	\$0
2.08 ELECTRONICS	(Y/N)	3	\$230,233	\$1,052,600	\$1,645,400	\$1,415,167
2.09 COMMUNICATIONS	(Y/N)	2	\$6,907	\$572,302	\$1,137,698	\$1,130,791
2.10 CAR WASH/CAR CLEANING	(Y/N)	2	\$144,470	\$508,143	\$871,816	\$727,347
2.11 MAINTENANCE OF WAY SHOPS		4	\$66,700	\$1,633,059	\$5,314,598	\$5,247,898
2.12 MAINTENANCE OF WAY EQUIPMENT		2	\$27,261	\$41,900	\$56,539	\$29,278
2.13 REVENUE CENTER	Each	1	\$1,206,213	\$1,206,213	\$1,206,213	\$0
2.14 CENTRAL CONTROL	(Y/N)	1	\$10,159,345	\$10,159,345	\$10,159,345	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

EXHIBIT 3

RANGE OF UNIT COSTS

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
3.00 SYSTEMS	Linear Feet	5	\$179	\$482	\$878	\$699
3.01 SIGNAL SYSTEM	L.F. Guideway	5	\$54	\$198	\$443	\$388
3.02 ELECTRIFICATION	L.F. Guideway	5	\$92	\$241	\$448	\$356
3.03 COMMUNICATIONS	Total	4	\$196,121	\$7,477,427	\$17,348,680	\$17,152,559
3.04 FARE COLLECTION	Total	4	\$1,080,497	\$3,407,019	\$5,456,404	\$4,375,907

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

necessary to operate the different service levels. The systems with higher service levels were grouped at the higher unit cost range, while the other systems were mainly grouped in the lower unit cost range. The mean of systems unit costs therefore is not as pertinent as the two ends of the unit cost range.

Stations - - This asset category was fairly straight forward with the identification of components and definition of their individual characteristics. Stations were first designated by grade, and then by center and side platform locations. Unique station descriptors were included to identify special asset requirements and related cost impacts. These descriptors included platform length, escalator/elevator availability, disability access mode, and weather coverage. In addition, station access amenities were separately requested to define the cost impacts of such elements as parking areas and pedestrian overpasses.

The station unit cost summary is presented in Exhibit 4, where total station-related costs averaged about \$1.4 million per station overall. At-grade center platform stations were the least expensive with a minimum cost of \$180,000 for the most basic station design. The more complex of these at-grade stations reach almost \$1.0 million for center platforms, and almost \$2.0 million for side platform stations. Subway stations were as expected the most expensive ranging from almost \$7.0 million to \$25.2 million for the most extensive station. There were only three elevated stations constructed in the five study systems, which cost almost \$2.7 million. In addition, parking lots averaged about \$1.1 million and a passenger overpass was constructed for \$900,000.

Vehicles - - Revenue and non-revenue vehicles were included in this asset category. Revenue vehicles were identified by separate vehicle orders to differentiate any component and cost impacts. Only one light rail system (Sacramento) had a second vehicle order included in this time period and capital cost data base. Unique vehicle characteristics and/or special componentry were noted to identify unit cost impacts of each vehicle order. These included the make and manufacturer; size and layout

RANGE OF UNIT COSTS**EXHIBIT 4**

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
4.00 STATIONS	Each	5	\$180,861	\$1,431,936	\$3,205,143	\$3,024,282
4.01 AT-GRADE	Each	5	\$180,861	\$800,732	\$1,961,305	\$1,780,443
4.02 SUBWAY	Each	2	\$6,936,659	\$16,046,881	\$25,157,102	\$18,220,444
4.03 ELEVATED	Each	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0
4.04 PARKING LOTS	Total	2	\$731,214	\$1,137,154	\$1,543,093	\$811,878
4.05 PARKING GARAGES	Total					
4.06 PEDESTRIAN OVERPASSES	Total	1	\$908,360	\$908,360	\$908,360	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

NORTHEAST METRO CAPTIAL COST GUIDEWAY CONSTRUCTION

SECTION	DESCRIPTION	MILES	COST PER MILE (millions) == >		\$2.55	\$1.78	\$1.83
			GUIDEWAY COST PER MILE (millions)	A GUIDEWAY	C SIGNAL AND COMMUNICTN. SYSTEMS	F UTILITY RELOC. AND SPECIAL CONDITIONS	G ACQUISITION OF RIGHT OF WAY
CONRAIL's New York Short Line between Byberry and Cheltenham	Grade Separated ROW	6.70	\$1.85	\$12,395,000	\$17,085,000	\$0	\$12,261,000
Bridge separating METRO and CONRAIL tracks at Cheltenham	New Bridge	0.20	\$0.00	\$4,000,000	\$0	\$0	\$0
CONRAIL's New York Short Line between Cheltenham and abandoned Tabor Branch	Grade Separated ROW	2.90	\$1.85	\$5,365,000	\$7,395,000	\$0	\$5,307,000
Bridge connecting New York Short Line and Tabor Branch	Bridge	0.20	\$0.00	\$4,000,000	\$0	\$0	\$0
Tabor Branch between New York Short Line and Indiana Avenue	Grade Separated ROW	2.70	\$1.85	\$4,995,000	\$6,885,000	\$0	\$4,941,000
American Street between Indiana Avenue and Master Street	Center Reservation Private ROW	1.60	\$2.80	\$4,480,000	\$4,080,000	\$2,848,000	\$0
Cadwallader Street between Master Street and Girard Avenue	Street to be closed and converted to Private ROW	0.10	\$2.80	\$280,000	\$255,000	\$178,000	\$0
2nd Street between Girard and Germantown Avenue	Side of the Road Private ROW	0.10	\$3.10	\$310,000	\$255,000	\$178,000	\$0

NORTHEAST METRO CAPTIAL COST GUIDEWAY CONSTRUCTION

COST PER MILE (millions) = = >

A

\$2.55

C

\$1.78

F

\$1.83

G

GUIDEWAY
COST PER
MILE (millions)

SIGNAL AND
COMMUNICTN.
SYSTEMS

UTILITY RELOC.
AND SPECIAL
CONDITIONS

ACQUISITION
OF
RIGHT OF WAY

SECTION

DESCRIPTION

MILES

GUIDEWAY

GUIDEWAY

GUIDEWAY

GUIDEWAY

GUIDEWAY

Germantown Avenue between
2nd and Front Streets

Side of the Road
Private ROW

0.30

\$2.80

\$840,000

\$765,000

\$534,000

\$0

Front Street
between Germantown Avenue
and Noble Street

In Street

0.50

\$3.10

\$1,550,000

\$1,275,000

\$890,000

\$0

Willow Street between
Front and 3rd Streets

Tunnel under I-95
Aerial Structure

0.10

\$10.00

\$1,000,000

\$255,000

\$178,000

\$0

Aerial Structure

0.10

\$14.50

\$1,450,000

\$255,000

\$178,000

\$0

Willow Street
between 3rd and 11th Streets

Aerial Structure

0.70

\$14.50

\$10,150,000

\$1,785,000

\$1,246,000

\$0

Willow Street
between 11th and 12th Streets

Aerial Structure
(ramp down)

0.10

\$14.50

\$1,450,000

\$255,000

\$178,000

\$0

12th Street between
Noble and Chestnut Streets

In Street

0.70

\$3.10

\$2,170,000

\$1,785,000

\$1,246,000

\$0

Chestnut Street
between 12th and 5th Streets

In Street

0.60

\$3.10

\$1,860,000

\$1,530,000

\$1,068,000

\$0

5th Street between
Chestnut and Race Streets

In Street

0.30

\$3.10

\$930,000

\$765,000

\$534,000

\$0

5th Street between
Race and Callowhill Streets

Tunnel,
Side of road ROW

0.30

\$2.80

\$840,000

\$765,000

\$534,000

\$0

A-9

NORTHEAST METRO CAPTIAL COST PARKING AND STATION CONSTRUCTION

STATION	DESCRIPTION	COSTS PROPOSED STATION	COSTS PROPOSED PARKING	EXISTING PARKING SPACES	ADDITIONAL PARKING SPACES
Byberry	At-Grade Station	\$800,000	\$11,375,000	n/a	3,500
Bustleton	At-Grade Station	\$800,000	\$6,500,000	n/a	1,300
Krewstown	At-Grade Station	\$800,000	\$325,000	n/a	100
Rhawnhurst	At-Grade Station	\$800,000	\$7,500,000	n/a	2,000
Fox Chase *	Existing RRD Station	\$100,000	\$0	290	0
Ryers West *	Existing RRD Station	\$100,000	\$0	70	0
Ryers East (L1)	Below-Grade Station	\$1,200,000	\$125,000	n/a	50
Cheltenham (L2)	Relocated RRD Station	\$1,000,000	\$830,000	200	400
Lawndale	Existing RRD Station	\$100,000	\$0	0	n/a
Olney	Existing RRD Station	\$100,000	\$0	60	0
Feltonville	Below-Grade Station	\$1,200,000	\$0	n/a	0
American Street	On-Street	\$200,000	\$0	n/a	0
Spring Garden	On-Street	\$200,000	\$0	n/a	0
3rd & Willow	Elevated Station	\$2,600,000	\$0	n/a	0
Convention Center South	On-Street	\$800,000	\$0	n/a	0
12th & Market	On-Street	\$800,000	\$0	n/a	0
10th & Chestnut	On-Street	\$800,000	\$0	n/a	0
7th/8th & Chestnut	On-Street	\$800,000	\$0	n/a	0
5th & Market	On-Street	\$800,000	\$0	n/a	0
GRAND TOTAL		\$14,000,000	\$26,655,000	620	7,350

NOTE: * Indicates Parking Lots Owned by The City of Philadelphia

(L1) Potential lease agreement with Super Fresh Supermarket

(L2) Potential lease agreement with Cheltenham Township (Tacony Park Parking Lot)

NORTHEAST METRO CAPITAL COSTS SUMMARY

DESCRIPTION	COSTS
Guideway (A)	\$ 61,275,000
Signal and Communications (C)	\$ 46,155,000
Utility Relocation and Special Conditions (F)	\$ 10,324,000
Aquisition of Right of Way (G)	\$ 22,509,000
SUBTOTAL (Guideway Construction Items A, C, F and G)	\$140,263,000
Storage Yards and Maintenance Facility (B)	\$ 23,800,000
Parking and Stations (D)	\$ 40,655,000
Soft-Costs {H} (51.8% of Items A, B, C, D, F and G)	\$ 98,791,900
New Articulated Vehicles [201] at \$2,000,000 each	\$162,000,000
GRAND TOTAL	\$465,509,000

**NORTHEAST METRO
ANNUAL OPERATING EXPENSE AND REVENUE**

OPERATING EXPENSE

Operating Expense is calculated using a three variable method as required by the Federal Transit Administration. Milage Expense includes vehicle maintenance and propulsion power, Wage Expense (vehicle hours) includes operator wages and fringes, and Peak Vehicle Expense includes fixed overhead for facilities, general overhead, and claims expense.

MILAGE EXPENSE

Daily Round Trips (weekdays)	= 200
Round Trip Mileage	= 30
Operating Cost Per Mile	= \$ 2.00
Average Train Length	= 2 Cars

200 TRIPS X 30 MILES X \$2.00 X 2 CARS = \$24,000 PER DAY

OPERATOR WAGE EXPENSE

1.33 Hours Per Round Trip
\$24.00 Per Hour Wages and Fringes
1.1 Pay Hours Per Work Hour

200 TRIPS X 1.33 HOURS X \$24.00 X 1.1 = \$ 7000 PER DAY

TOTAL WEEKDAY EXPENSE	= \$ 31,000
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WEEKEND EXPENSE	= \$ 20,666
(2/3 of Weekday Cost)	

PEAK VEHICLE EXPENSE

78 Vehicles x \$100,000	= \$7,800,000
TOTAL ANNUAL OPERATING EXPENSE	=\$16,842,000

ANNUAL REVENUE

Weekday passengers	= 35,000
Weekend passengers	= 24,000
Average Fare	= \$ 0.85
ANNUAL REVENUE	= \$8,700,000
OPERATING RATIO	= 51.6%

**POTENTIAL OPERATING COST SAVINGS
BUS AND REGIONAL RAIL SERVICE REVISIONS
NORTHEAST METRO**

<u>ROUTE</u>	<u>CURRENT COST</u>	<u>% SAVING</u>	<u>COST SAVING</u>
8	\$ 980,700	10	\$ 98,000
14/20	\$10,839,500	10	\$ 1,084,000
18	\$ 7,857,900	10	\$ 786,000
19/67	\$ 4,809,000	25	\$ 1,202,000
24	\$ 1,689,800	10	\$ 169,000
26	\$ 2,969,800	10	\$ 297,000
28	\$ 1,314,300	10	\$ 131,000
58	\$ 4,995,400	10	\$ 499,000
59	\$ 2,024,000	5	\$ 101,000
70/16	\$ 5,289,300	10	\$ 529,000
88	\$ 3,109,600	10	\$ 311,000
R8 FOX CHASE	\$ 5,969,000	100	\$ 5,969,000
TOTAL	\$51,848,300		\$11,176,000

**TRAVEL TIME COMPARISON
FROM NORTHEAST PHILADELPHIA
TO CENTER CITY (12th AND MARKET)**

NORTHEAST METRO VERSUS PRESENT SERVICE

<u>STATION</u>	<u>PRESENT TRAVEL TIME (minutes)</u>	<u>VIA ROUTES</u>	<u>FUTURE TRAVEL TIME (minutes)</u>
Byberry	59	14 and MFL	32 *
	34*	R3 (Somerton)	32 *
Bustleton	57	58 and MFL	30 *
Krewstown	55	19 and MFL	28 *
Rhawnhurst	46	19 and MFL	25 *
Ryers East	38	67 and MFL	23 *
Cheltenham	22	R8	25
Lawndale	20	R8	23
Olney	16	R8	21
Fox Chase	27	R8	29
Ryers	24	R8	27

* - Travel Times shown are for peak period express service.

**POTENTIAL OPERATING COST SAVINGS
BUS AND REGIONAL RAIL SERVICE REVISIONS
NORTHEAST METRO**

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59	\$ 2,024,000	5	\$ 101,000
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R8 FOX CHASE	\$ 5,969,000	100	\$ 5,969,000
TOTAL	\$51,848,300		\$11,176,000